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Pain Catastrophizing Scale as a predictor of low postoperative satisfaction after hand surgery

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ABSTRACT

Background: Psychological measures are used increasingly in outcome studies. The Pain Catastrophizing Scale is a 13-item questionnaire used to measure coping skills and negative feelings of pain. In the existing literature it is suggested that the Pain Catastrophizing Scale could be associated with the outcome following surgery. The aim of this study was to examine the effect of catastrophic thinking on postoperative satisfaction after treatment for hand conditions where pain is not the predominant symptom (Dupuytren's disease, trigger finger and wrist ganglia), and further to estimate cut-points on the Pain Catastrophizing Scale.

Methods: A total of 413 patients (53% females) with a mean age of 59 years were included in this one-year prospective follow-up study. The patients were diagnosed with either Dupuytren's disease (N = 133), trigger finger (N = 365), or wrist ganglia (N = 147). Preoperative data included disability (Disability of the Arm, Shoulder and Hand questionnaire (DASH)), quality of life (EuroQol-5D (EQ-5D)), and pain catastrophizing (Pain Catastrophizing Scale (PCS)). One year postoperative, data on DASH score, EQ-5D, and patient satisfaction were collected. We used a classification tree to define the most important cut-points, which could classify patients as low-risk or high-risk of low postoperative satisfaction. These cut-points and the 75th percentile cut-point was then used in logistic regression models with postoperative satisfaction as outcome variable.

Results: The median DASH score improved from 13.5 to 2.6 ($p < 0.01$), and the median EQ-5D score improved from 0.82 to 1.00, and 90.3% of patients were satisfied or very satisfied with the surgery.Using the 75th percentile (≤12) we did not find a predictive effect of PCS. However, when using the two cut-points from the classification tree (≤27.5 & ≤2.9) all tested models were statistically significant with odds ratios for risk of low satisfaction ranging from 2.81 to 6.44. Only the model using PCS ≤27.5 adjusted for both demographics and disability was insignificant.

Conclusion: This study suggests that PCS can be a valuable tool in predicting postoperative satisfaction in hand conditions where pain is not the predominant symptom, and that ≤27.5 and ≤ 2.9 are the optimal cut-point on the preoperative PCS.

1. Background

Musculoskeletal disorders (MSDs) is one of the main reasons for patients to be referred for assessment by a hand surgeon. Functional improvement after hand surgery is well studied, and beside using function, disability and pain as outcome measures, there has been an increasing interest in patient satisfaction data to assess the quality of surgical care.[1] Several studies suggest that psychological factors are determinant of health and that postoperative pain following surgical treatment of soft tissue disorders of the hand can be influenced by psychological factors.[2]

The relationship between psychological factors and various outcome measures has been examined in Carpal Tunnel Syndrome (CTS) and distal radius fractures (DRF).[3–6] Three out of five studies in a systematic review showed a statistically significant correlation between psychological measures of depression and heath and patient satisfaction in patients with CTS.[3] Catastrophic thinking measured using the Pain Catastrophizing Scale (PCS) was found predictive of greater finger stiffness after surgery of DRF.[7] In a study on several atraumatic hand disorders they found that patients scoring above 30 on the PCS had poorer score on the Michigan Hand Outcomes Questionnaire (MHQ), compared to patients scoring 30 or below .[8] The effect of PCS on postoperative satisfaction following surgery of soft tissue disorders, where pain is not the predominant symptom, is not equally well

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examined, although it is suggested that psychological factors might affect patient satisfaction in Dupuytren's patients.[9] Further, a recent study on patients with trigger finger suggested that catastrophic thinking of pain might affect the postoperative outcome.[10]

It is of interest to detect preoperative factors associated with postoperative patient satisfaction, as it enables physicians to identify patients that may not benefit from surgical intervention. Dupuytren's disease, trigger finger and wrist ganglia are common hand and wrist disorders causing mainly functional limitations and disability, and little is known about the predictive value of PCS on postoperative outcome in these patients.[9,11,12] Therefore, the aim of this study was to investigate the effect of PCS on postoperative satisfaction in patients with Dupuytren's disease, trigger finger and wrist ganglia. For predictive purpose and better clinical use, we further aimed to evaluate the optimal preoperative cut-point on the PCS to identify patients with increased risk of low postoperative satisfaction.

2. Methods

Prior to study initiation, the protocol was reviewed by the local research ethics committee, and no specific approval was demanded as the study is a quality assurance study, which according to the Danish law "Act on a Biomedical Research Ethics Committee System and the Processing of Biomedical Research Projects", Part 3 "Notification and authorization": Questionnaire-based projects and register research projects shall only be notified to a regional committee if the project also involves human biological material. The project was registered with The Danish Data Protection Agency (jr. nr.: 2007-58-0010) and informed patient consent was obtained. The Helsinki II declaration was followed, and all data was handled according to the General Data Protection Regulation (GDPR).

2.1. Study sample

645 patients were enrolled in a prospectively updated database between February 11th, 2011 and January 5th, 2015. Patients were diagnosed with and surgically treated for Dupuytren's disease (N = 133), trigger finger (N = 365), or wrist ganglia (N = 147). Due to missing data on the outcome score, patient satisfaction score, or multiple surgeries a total of 232 patients were excluded leaving 413 patients for analysis. The excluded patients were younger and more likely to be living alone. Patient demographics for the included and excluded patients can be seen in Table 1. A comparison of the baseline scores between diagnosis groups is shown in Table 2.

2.2. Measures

The study was designed as a prospective study with follow-up measures one year after surgery to ensure full recovery after the surgery. The patients were asked to complete a questionnaire prior to surgery on Pain Catastrophizing Scale (PCS), Disability of Arm, Shoulder and Hand (DASH), and EuroQol-5D (EQ-5D). One year postoperatively the patients were asked to complete a questionnaire on DASH, EQ-5D, and satisfaction with the surgery.

Table 1
Preoperative baseline characteristics for included and excluded patients.

	Included patients (N = 413)		Excluded patients (N = 232)	
	Mean	95% CI	Mean	95% CI
Females	52.8%	.	58.2%	.
Dominant hand	58.0%	.	59.8%	.
Living alone	22.3%	.	29.2%	.
Age (years)	58.8	57.4–60.3	49.2	45.9–52.5
DASH	14.8	13.2–16.4	17.7	14.5–20.8
EQ-5D	0.8	0.8–0.9	0.8	0.8–0.8
PCS	7.6	6.5–8.5	8.8	7.4–10.3

Table 2
Comparison of baseline scores between diagnosis groups.

Diagnosis N	Dupuytren's	Trigger finger	Wrist ganglia
	105	223	85
Age, mean	64.1	62.3	50.7
95% CI	62.1–66.2	60.9–63.7	47.0–54.3
PCS, mean	5.1	9.8	6.6
95% CI	3.6–6.7	8.6–10.9	5.0–8.2
DASH, mean	9.3	21.1	11.7
95% CI	7.6–11.0	19.1–23.0	8.9–14.5
EQ-5D, mean	0.88	0.78	0.85
95% CI	0.86–0.90	0.77–0.80	0.81–0.88

The primary preoperative measure of interest in this study was PCS. PCS is a 13-item questionnaire used to measure coping skills and negative feelings of pain on a scale from 0 to 52. Each of the 13 statements have 5 answering options ranging from 0 "not at all" to 4 "all the time" where a higher score reflects higher catastrophic thinking. The 30-item DASH questionnaire was used to measure patient disability through 30 statements, which each are scored on a 5-point Likert scale, where a higher score reflects more disability on a scale from 0 to 100 In this study, a Danish translated and validated version of DASH was used.[13] Finally, the patients completed the health-related quality of life questionnaire EQ-5D, where a higher score indicates a better health-related quality of life. In the 1-year postoperative questionnaire, the patients where further asked to evaluate their satisfaction with the treatment on a score ranging from 1 "I am very satisfied" to 4 "I am dissatisfied". We then pooled scores of 1 or 2 as satisfied and scores of 3 or 4 as dissatisfied.

In the final study cohort of 413 patients, we had missing data on preoperative PCS (14.04%), preoperative DASH (9.44%), preoperative EQ-5D (6.05%), postoperative DASH (7.27%), postoperative EQ-5D (3.39%), dominant hand (2.66%), and civil status (1.94%). This data was addressed using the "missForest" function in the software R, as it handles missing data of both continuous (PCS, DASH and EQ-5D) and/or categorical types (dominant hand and civil status).

3. Statistics

Data normal distribution was assessed using quantile-quantile plots. Due to non-normality, Wilcoxon matched-pairs signed-rank test was used to test for change in preoperative and postoperative DASH and EQ-5D score. We used Pearson's correlation to assess the correlation between preoperative measures of PCS, DASH and EQ-5d. We used the package "tree" in R (R Core Team (2013), R Foundation for Statistical Computing, Vienna, Austria) to generate a classification tree to decide the optimal cut-point on the continuous preoperative PCS (https://cran.r-project.org/web/packages/tree/tree.pdf).

The classification tree splits the independent variable in order to find optimal cut-points related to a given outcome variable, in this case the one-year postoperative patient satisfaction. The two most important cut-points were then used for further analysis. Beside these two cut-points, we used the 75th percentile on the PCS (PCS ≤ 12) as a cut-point as it is used in the PCS manual[14] and finally PCS as a continuous variable without dividing it into two groups. The three cut-points and the continuous PCS were then each used in three logistic regression models with different adjustments.

First, we performed unadjusted logistic regression models on the effect of preoperative PCS (the 3 cut-points and continuous) on

postoperative satisfaction. Next, we tested the same models but this time adjusted for demographics (age, gender, dominant hand, civil status). Finally, we further adjusted the models for disability (EQ-5D score and DASH).

Descriptive statistics and logistic regression models were made using STATA, version 15 IC (Stata Corp, College Station, TX, USA). Imputation, data cleaning and regression trees were made in R (R Core Team (2013), R Foundation for Statistical Computing, Vienna, Austria).

4. Results

Patients improved statically significant in both DASH- and EQ-5D score from the preoperative assessment to the postoperative. The median DASH score improved from 13.5 to 2.6 ($p < 0.001$) and the median EQ-5D score improved from 0.82 to 1.00 ($p < 0.001$). DASH score improvement was close to the minimal clinical important difference (MCID) of 12[15] and EQ-5D score improved more than the MCID of 0.10.[16] Furthermore, 90.3% of the patients were either satisfied or very satisfied with the surgery one year postoperatively.

4.1. Preoperative cut-points on the PCS

The first estimated cut-point on the preoperative PCS from the classification tree was ≤27.5. Using this cut-point, we found a higher percentage of dissatisfied patients in the group scoring PCS above the estimated cut-point, with 36.4% in the high PCS group reporting low satisfaction compared to 9.0% of patients in the low PCS group reporting low satisfaction ($p < 0.01$).

The second estimated cut-point on the preoperative PCS was ≤2.9. We also found more dissatisfied patients in the high PCS group using this cut-point. In the high PCS group, 12.50% reported low satisfaction, and in the low PCS group, 4.26% reported low satisfaction ($p < 0.01$). Using the 75th percentile (PCS≤12), 12.62% reported low satisfaction in the high PCS group and 8.71% reported low satisfaction in the low PCS group ($p = 0.25$).

4.2. Logistic regressions using different cut-points

Preoperative continuous PCS: Without using a cut-point on the PCS there was a significant negative effect of increased preoperative PCS on postoperative patient reported satisfaction (OR = 1.04 [95% CI: 1.00–1.07]) in the simple logistic regression model and the logistic regression model adjusted for demographics ($p < 0.04$). When we further adjusted this model for preoperative disability, the model was no longer statistically significant for prediction of a low postoperative satisfaction ($p > 0.41$).

Preoperative PCS cut 75th percentile: When we divided the patients into high and low PCS using the 75th percentile as cut-point (PCS≤12) there was no significant effect of PCS on postoperative patient satisfaction in any of the three models ($p > 0.17$).

Preoperative PCS cut ≤27.5: Using the first estimated cut-point (PCS≤27.5) we found a statistically significantly increased risk of low postoperative satisfaction in the high PCS group both when unadjusted (OR = 5.81 [95% CI: 1.62–20.80]) and when adjusted for demographics (OR = 6.44 [95% CI: 1.65–25.14]) ($p < 0.01$).

Preoperative PCS cut ≤2.9: In the last model, we used the secondary cut-point (PCS≤2.9) and found a statistically significant effect in all three models. The highest OR was in the model adjusted for demographics (OR = 3.82 [95% CI: 1.51–9.61]) ($p < 0.01$) and the lowest OR was in the model adjusted for demographics and disability (OR = 2.81 [95% CI: 1.05–7.48]) ($p < 0.04$). All results from the logistic regression models can be seen in Table 3.

4.3. Correlation between PCS, EQ-5D and DASH score

We found significant correlations between all three preoperative scores ($p < 0.01$). The highest correlation was found between preoperative DASH and preoperative EQ-5D ($r = -0.72$). The second strongest correlation was between preoperative PCS and preoperative DASH ($r = 0.53$). Weakest was the correlation between preoperative PCS and preoperative EQ-5D ($r = -0.43$).

Table 3
Logistic regression models on the odds ratio for postoperative dissatisfaction predicted by preoperative score on the Pain Catastrophizing Scale.

Preoperative	Odds ratio for low patient reported satisfaction after minor hand surgery		
	Odds ratio	95% CI	p value
PCS			
Unadjusted[a]	1.04	1.00–1.07	0.038*
+ Demographics[b]	1.04	1.01–1.08	0.024*
+ Disability[c]	1.02	0.98–1.06	0.417
PCS > 27.5			
Unadjusted[a]	5.81	1.62–20.80	0.007*
+ Demographics[b]	6.44	1.65–25.14	0.007*
+ Disability[c]	3.71	0.88–15.68	0.074
PCS > 12			
Unadjusted[a]	1.51	0.75–3.06	0.247
+ Demographics[b]	1.65	0.79–3.43	0.179
+ Disability[c]	0.91	0.38–2.17	0.835
PCS > 2.9			
Unadjusted[a]	3.21	1.32–7.85	0.010*
+ Demographics[b]	3.82	1.51–9.61	0.005*
+ Disability[c]	2.81	1.05–7.48	0.038*

Table 3: Logistic regression analysis on the association between preoperative score on the Pain Catastrophizing Scale and patient reported satisfaction 1 year after minor hand surgery. *: Denotes statistical significance. a: Unadjusted association logistic regression model. b: Adjusted for age, gender, living alone and dominant hand. c: Adjusted for age, gender, living alone, dominant hand, preoperative EQ-5D and preoperative DASH score.

5. Discussion

Patients treated surgically for Dupuytren's disease, trigger finger and wrist ganglia generally improved in both EQ-5D and DASH score from preoperative to one year postoperative. More than 90% of patients felt either satisfied or very satisfied one year after surgery, and there was no difference between diagnosis groups. However, this implies means that almost 10% were dissatisfied, and we showed that preoperative PCS margin scores ≤27.5 and ≤ 2.9 significantly increased the risk of low postoperative satisfaction, and can be a useful preoperative tool to identify patients at risk of feeling low satisfaction after surgery for Dupuytren's disease, trigger finger or wrist ganglia.

5.1. Pain Catastrophizing Scale

The existing literature shows mixed findings regarding the association between PCS and various outcomes. A study on patients with Carpal Tunnel Syndrome found a higher PCS to be associated to a higher DASH score but no association between PCS and patients satisfaction.[5] However, a higher PCS has also been found to be associated to lower postoperative patient satisfaction in CTS patients.[17] Additionally, a study from South Korea in patients with distal radius fractures found an association between PCS and range of motion and grip strength at 4 weeks but not at 12 weeks.[6] It is suggested that patients with high PCS might be more cautious about using their arm and hand after surgery, which could lead to reduced range of motion and grip strength. This study did not define cut-points on the preoperative PCS, which is necessary to identify patients at risk.

Our study showed that the predictive effect of PCS on postoperative satisfaction depended on the cut-point. The PCS manual defines a PCS score of 30 as a clinically relevant pain catastrophizing, representing the 75th percentile in chronic pain patients.[14] Using this cut-point, an

American study on patients suffering from atraumatic hand disorders found that patients with a PCS score > 30 had a higher score on the Michigan Hand Outcomes Questionnaire (MHQ) at baseline. However, the improvement in MHQ over time was the same for patients with PCS score > 30 and patients with PCS score ≤ 30.[8] A Korean study on patients surgically treated for hand fractures examined the effect of preoperative PCS on grip strength, range of motion and disability 3 and 6 months after surgery.[18] In this study, they also used the 75th percentile as cut-point which in this study represented a PCS score of 27. Using this cut-point, they found an association between PCS and grip strength, range of motion and disability 3 months postoperatively, but not 6 months postoperatively.

5.2. The optimal cut-point

In our study on patients with Dupuytren's disease, trigger finger and wrist ganglia we used three different cut-points and examined if this would lead to different results. Using a classification tree, we found the two most important cut-points to be 27.5 and 2.9. Additionally, we used the 75th percentile as cut-point, which in our study was a PCS score of 12. This is lower than we have seen in other studies as the patients in our study generally scored lower on the PCS. Using 12 as cut-point was the only time, we did not find an association in either the unadjusted regression, the demographics adjusted regression, or the demographics and disability adjusted regression, which indicate that the 75th percentile is not a useful cut-point in our data. Using the two cut-points from the classification tree we found statistically significant predictive effects of PCS in all the models besides the demographics and disability adjusted regression with PCS ≤ 27.5. Given our results, we are unable to state whether 2.9 or 27.5 is the most important cut-points as there is a large difference in false positives and false negatives between these cut-points. However, this study indicates that using the 75th percentile as cut-point might be unsuitable given that this was the only cut-point without statistically significant predictive effect.

5.3. Considerations

We excluded almost 36% of the included patients due to missing data. The excluded patients were younger, more likely to be living alone and slightly more of these were females, which might have led to bias. Additionally, the suggested cut-points in this study is not necessarily the optimal cut-points in other samples, since our cut-points has not been externally validated, but we encourage this to be done. Also, the use of DASH as a measure of disability might affect the validity negatively. DASH targets both the arm, shoulder and hand, which could cause musculoskeletal problems in anatomical sites other than the hand to affect the validity of the disability score. Further studies on patient satisfaction should include additional information such as patient smoking habits, alcohol consumption, BMI, education and income to strengthen the explanatory power.

6. Conclusion

Patients generally improved in EQ-5D and DASH score and more than 90% of the patients was either satisfied or very satisfied one year postoperatively. We tested three different cut-points on the preoperative PCS to predict postoperative patient satisfaction. Using the 75th percentile (≤12) we did not find a predictive effect of PCS. However, when using the two cut-points from a classification tree (≤27.5 & ≤2.9) all tested models were statistically significant with odds ratios for risk of low satisfaction ranging from 2.81 to 6.44. Only the model using PCS ≤27.5 adjusted for both demographics and disability was insignificant. This study suggests that PCS can be a valuable tool in predicting postoperative satisfaction in hand surgery. Further, the results from this study indicates that using the 75th percentile as cut-point on the PCS might not be the optimal solution in prediction studies. Finally, we suggest that the cut-points should be validated on external data in order to investigate the external validity of our suggested cut-points.

Declaration of competing interest

None.

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